FRESH MEAT PACKAGING

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Goals of Food Packaging

- Preserve foods
- Protect foods
- Prevent contamination of foods
- Aid consumers in use of product
- Unitize or Group products
- Communicate and Educate the Consumer

Package/Container Types/Levels

- Primary
  - Comes in direct contact with food
    - Preformed, e.g. jars, cans, plastic containers
    - Formed, in-line from roll stock, flat blanks
- Secondary
  - Outer box or case
  - Often unitizes
  - Sometimes protects primary package, i.e. glass jars
- Tertiary
  - Group several secondary cartons together - pallet loads etc…

Goals of Food Packaging – for fresh meat products

- PRIMARY GOALS
  - Prevent dehydration
  - Promote good meat color
  - Prevent contamination - microorganisms
  - Limit gas exchange – H_2O, O_2
  - Slow microbial growth
- SECONDARY GOALS
  - Communicate and Educate the Consumer
    - Product Label
    - Nutrition Label
    - Safe handling label
  - Aid consumers in use of product
    - Cooking/Preparation Instructions

Requirements of food packaging materials

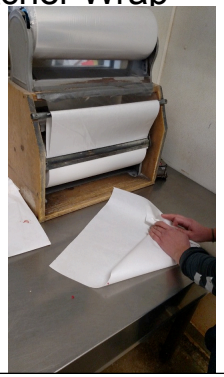
1. Nontoxic
2. Protect against contamination from microorganisms
3. Barrier to moisture and oxygen
4. Protect against odor ingress or environmental toxicants
5. Filter out harmful UV light
6. Resist physical damage
7. Transparent
8. Tamper-resistant/tamper evident
9. Easy to open
10. Dispensing and resealing features
11. Easy disposal
12. Meet size, shape and weight requirements
13. Have desired appearance and printability features
14. Low cost
15. Compatible with food
16. Unitizing features

Meat Packaging Types

- Butcher Paper, waxed – frozen meat
- Plastic under-wrap/Butcher Paper over-wrap – frozen meat

Packaging Materials – Butcher Wrap

- Butcher Paper, waxed
  - Prone to freezer burn and oxidation under prolonged storage
- Plastic under-wrap/Butcher Paper over-wrap
  - Much less prone to freezer burn and oxidation
  - Depends on air space between product and package



Freezer Burn

- Dehydration of the food, muscle
- Primarily caused by sublimation
  - Sublimation - phase transition directly from solid to gas, ice to water vapor
- Exacerbating Factors
  - Loose packaging
  - Temperature fluctuations (auto-defrost freezers)
  - Relatively high frozen food temperatures
- Also promotes oxidation causing off flavors/odors, and pigment discoloration

Meat Packaging Types

- Butcher Paper, waxed – frozen meat
- Plastic under-wrap/Butcher Paper over-wrap – frozen meat
- Tray Over-wrap – fresh meat

Packaging Materials – Tray Over-wrap

Polyvinyl Chloride

- Low H_2O transmission
  - Prevents dehydration
- High O_2 transmission
  - Oxymyoglobin
- Oxymyoglobin – bright cherry red
- Purge or Weep
  - Red liquid (Sarcoplasm) in package
  - Diaper/soaker pad
- 3 day refrigerated shelf life

Fresh Beef Color

MYOGLOBIN NAME	IRON STATE	BOUND LIGAND	COLOR
Deoxymyoglobin	Fe^{+2}	H_2O	Dark Purple
Oxymyoglobin	Fe^{+2}	O_2	Bright Cherry Red
Metmyoglobin	Fe^{+3}	None	Brown, uncooked meat
Denatured Metmyoglobin	Fe^{+3}	None	Brown, cooked meat

Fresh Beef Color

Meat Packaging Types

- Butcher Paper, waxed – frozen meat
- Plastic under-wrap/Butcher Paper over-wrap – frozen meat
- Tray Over-wrap – fresh meat
- Vacuum package – fresh or frozen meat, processed meats

Packaging Materials – Vacuum Package

Laminates - Composite Polymer Films

Eliminate O_2/Eliminate O_2

- Oriented Polypropylene, Polyethylene
  - Low H_2O transmission
- Polyvinylidene Chloride, Ethylene Vinyl Alcohol
  - Low O_2 transmission
- Extended refrigerated shelf life, 3 weeks or longer
- Deoxymyoglobin – dark purple

Factors Affecting Microbial Growth in Foods

INTRINSIC PARAMETERS

- pH
- Moisture content, Aw
- Oxidation-Reduction potential
- Nutrient Content
- Antimicrobial Constituents
- Biological Structures

EXTRINSIC PARAMETERS

- Storage Temperature of Environment
- Relative Humidity of Environment
- Presence & Concentration of Gases in the Environment

INTRINSIC PARAMETERS

- pH
  - ~5.4 for post-rigor beef
  - Not low enough to inhibit microbial growth, neutral = pH 7.0
  - May manipulate in processed meats
    - Acidified sausage has pH < 5.0
    - Cooked Roast beef may have pH = 6.0

INTRINSIC PARAMETERS

- Moisture content, Aw (water activity)
  - Pure water Aw = 1.0
  - Fresh meat has a high moisture content, ± 75%; Aw = 0.99
  - May manipulate for processed meat products
    - Dried Sausage
    - Jerky, Aw = 0.85 or below

INTRINSIC PARAMETERS

- Oxidation-Reduction potential
  - Tray over-wrap package has an Oxidation type environment.
    - Bacteria requiring O_2 can grow
      - These bacteria grow relatively fast, even at refrigeration temperatures
  - Vacuum or MAP Packaging quickly produces a Reducing type environment
    - Only anaerobic and facultative anaerobic bacteria can grow
      - These bacteria grow relatively slower at refrigeration temperatures

INTRINSIC PARAMETERS

- Nutrient Content
  - Meat is a relatively good source of nutrients
- Antimicrobial Constituents
  - None in fresh meat
  - May be added to processed meats – salt, nitrite
- Biological Structures
  - No longer present

EXTRINSIC PARAMETERS

- Storage Temperature of Environment
  - Meat stored at refrigeration temperatures (< 40°F) or frozen
  - Slows microbial growth
- Relative Humidity of Environment
  - RH is kept high to deter dehydration

EXTRINSIC PARAMETERS

- Presence & Concentration of Gases in the Environment
  - If O_2 is present, e.g. Tray Over-Wrap, microbial growth is faster.
  - If O_2 is not present, e.g. Vacuum, Fill & Form Vacuum, MAP, microbial growth at refrigeration temperatures is much slower.

Factors Affecting Microbial Growth in Fresh Meat

INTRINSIC PARAMETERS

- ~~pH~~
- ~~Moisture content, Aw~~
- Oxidation-Reduction potential
- ~~Nutrient Content~~
- ~~Antimicrobial Constituents~~
- ~~Biological Structures~~

EXTRINSIC PARAMETERS

- Storage Temperature
- ~~Relative Humidity of Environment~~
- Presence & Concentration of Gases in the Environment

Meat Packaging Types

- Butcher Paper, waxed – frozen meat
- Plastic under-wrap/Butcher Paper over-wrap – frozen meat
- Tray Over-wrap – fresh meat
- Vacuum package – fresh or frozen meat, processed meats
- Tray Over-wrap in Master Pack – MAP fresh meat
- Form & Fill Vacuum Package – fresh or frozen meat, processed meats

Packaging Materials – Form & Fill

Laminates - Composite Polymer Films

Eliminate O_2/Eliminate O_2

- Similar materials/traits to vacuum package
- Faster fill & seal rates
- More durable films
- May be more desirable package shape; printability
- Higher cost

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- Tray Over-wrap in Master Pack – MAP fresh meat
- Form & Fill Vacuum Package – fresh or frozen meat, processed meats
- Modified Atmosphere Package – fresh meat, processed meats
  - Tray Fill – MAP fresh meat, MAP processed meats

Packaging Materials – MAP

Modified Atmosphere Packaging

- ~80% N_2
- ~20% CO_2
- 0.4% CO
- Stabilizes meat pigment
- Reduces microbial growth
- Highest cost

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- Form & Fill Vacuum Package – fresh or frozen meat, processed meats
- Modified Atmosphere Package – fresh meat, processed meats
  - Tray Fill – MAP fresh meat, MAP processed meats
- Chubs – ground beef

Packaging Materials – Chubs

HD Plastic Film

Eliminate O_2

- Not vacuumized
  - Interior quickly becomes anaerobic due to O_2 consumption by muscle metabolic activities
- Very fast fill & seal rates
- Very durable film
- Cannot see product
- Used for ground meat products


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